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AUTHOR Barrow, Lloyd H.
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ABSTRACT

Reported is a study of sixth-graders' attitudes towards electrical energy. Students in Catawba County, North Carolina schools, which field-tested the Energy for Today and Tomorrow (EFTT) module, completed a 17-item attitude test, the Environmental Opinion Scale. This instrument measured opinions regarding nuclear power, electrical power generation, and the environmental impact of power generation. Three treatments were administered: (1) the EFTT module, (2) a different energy unit, and (3) no treatment. The small sample size of the EFTT group did not permit judgments about the influence of EFTT on attitudes to be made. However, analyses of variance performed upon posttest data from all groups revealed several statistically significant findings related to male-female attitude differences and differences in attitudes between treatment groups. (WB)

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A Study of Sixth-graders Energy Attitudes:

Evaluation of an Energy Module

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Lloyd H. Barrow
College of Education
University of Maine at Orono
Orono, Maine 04469

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The status of energy education has not changed markably since reported by Glass (1979). The vast majority of articles continue to concentrate on techniques to use solar energy, pros and cons in the nuclear controversy, and ways to conserve energy in transportation, business, school and home. During the 1980's, energy related concerns will continue to cause problems for American citizens, for both adults and children. National Assessment of Educational Progress (1978) indicated that adults lack the necessary knowledge to make informed decisions about energy.

The Problem

A concern for science educators during the 80's will include the development of classroom activities in energy education that affect the knowledge, conservation, and attitudes of elementary students. The purpose of this study was to measure the attitudes of sixth graders toward electrical energy. More specifically, the purposes of the study were:

1) measure the attitudes regarding electrical energy at schools that field-tested the energy module, Energy for Today and Tomorrow (EFTT) in the Catawba County Schools, North Carolina.

2) compare the attitudes between the group that used EFTT, the group that studied scientific principles of energy, and the control group.

3) measure the change in attitudes on the pre-post assessment for a pilot group.

4) compare male and female difference in attitudes toward electrical energy.

Description of the Study

A seventeen (17) item instrument, Environmental Opinion Scale (EOS), modified by Ayres (1976) of the Pennsylvania Department (McDermott, 1973) was utilized to ascertain the attitudes of sixth graders toward electrical energy. EOS contained items that could be grouped into three broad

categories--nuclear power, electrical power generation, and environmental impact of electrical power generation. All three areas were integral components of EFTT, especially the components about energy consumption and attitudes toward energy. In addition, EOS was selected because electrical energy was the dominant home heating source utilized in the Catawba County area. Each of the seventeen items allowed the subjects to respond on a five point scale--strongly agree to strongly disagree. Data was collected from October, 1978 to March, 1979.

EFTT module was developed by an interdisciplinary team of sixth grade teachers and secondary science teachers. An energy mini-grant from the Education Department of the State of North Carolina supplied the funds for development and construction of EFTT. EFTT utilized a combination of hands-on learning experiences, learning centers, home research topics, and group discussions which incorporated value clarification activities. The module was developed during the summer of 1978. A one day inservice session was conducted by the development team for all field test teachers. Field test sites were selected by the project director on a teacher volunteer basis. The classrooms were considered heterogenous in composition. Each of the field test sites provided specific contribution toward analysis of the data (See Figure 1). Data was analyzed by SPSS (Nie, 1975).

At one site (School C), a random sample of students (chosen by the teachers) were selected to participate in a pre-post design of EFTT. Twelve (12) males and eleven (11) females were administered the EOS. EFTT did cause greater positive attitude toward energy as measured by EOS. Even though the composite score was not significant (0.067), several items had significant change (Table 1). EFTT caused greater change in energy attitudes for females than it did for males (Tables 2 and 3). Tables 4 and 5 allows comparison by age for both males and females. With exception

for the single thirteen-year old male, EFTT resulted in more positive attitude toward electrical energy as measured by EOS. Therefore, it can be inferred that EFTT did bring about a change in energy attitudes--although the small N did not allow for a final decision about EFTT. Therefore, an ANOVA was done to ascertain the impact of EFTT upon the total population comprising the study. The design of the study was post-test only.

Findings

Generally, males were more cautious than females in their attitudes toward electrical energy, except for eleven-year old females that studied EFTT. In addition, twelve-year olds were more cautious than eleven-year olds (Tables 6, 7, and 8). The ANOVA for the EFTT, control, and energy groups showed that there was significant interaction (Table 9). Due to the significant interaction, the design was partitioned into four separate one-way ANOVA. This analysis indicated that the significant interaction was caused by the control male group. Thus, the use of the EFTT provided more opportunities for the development of positive attitudes toward electrical energy for males than females.

The ANOVA for attitudes toward nuclear power showed a significant main effect for sex, favoring males (Table 10). There was a significant interaction for attitudes toward environmental impact of electrical power generation (Table 11). Regarding the attitudes toward electrical power generation, there was no significant main effects or interaction (Table 12). The split-half reliability for EOS was 0.486 for this study.

There was no significant difference between the group that studied energy concepts and the control group for total score (Tables 13-15). There was a significant difference between EFTT and the group that studied

energy concepts total score for males (Table 17). However, there was not an overall difference for females and composite groups (Tables 16 and 18).

Discussion

The subjects in the present study were more cautious than the 496 fifth sixth, and seventh graders that Ayres surveyed in February, 1974 (Ayres, 1976). Since 1974, energy related problems have received greater media coverage. The gas shortage problems (i.e. gas lines, Iran oil embargo, etc.) were experienced by more people in the late seventies than they were in 1973-74 in North Carolina. Since data was collected, two additional events could have influenced electrical energy attitudes--Three-Mile Island and the movie "The China Syndrome." Barrow (1980) found that six weeks after Three-Mile Island was reported, sixth graders attitudes toward nuclear energy had been modified.

The present study substantiates Ayres (1976) results that there is no significant total score variation by sexes. Ayres utilized the Chi square technique; therefore, the significant interaction observed can not be determined whether it is only for the groups utilized in this study. The overall total score ranking from most to least positives for males was Schools A, D, B, and C, while for females the ranking from most to least positive was Schools D, C, B, and A. This could have produced bias in the study since the control groups were at Schools A and B.

Considering the inadequate energy background of adults (National Assessment, 1978), science educators need to confront the problem at three levels--students (K-12) in school today, preservice teachers, and inservice programs for teachers. At each of these levels, emphasis should be provided at both the knowledge and attitude levels. Many states, organizations,

and local education agencies have developed energy education components, such as EFTT. These developed materials need to be evaluated and improved.

Energy Education is an area of interdisciplinary study that can not be ignored. The energy problems of the 1970's will not disappear in the 1980's because their cause was established by several previous decades. It is hard to break the habit of turning on a light when you enter a room when the sun is providing enough lumens to accomplish the desired task. Therefore, one task for science education in the 80's is to prepare adults to teach students about energy effectively. Energy education is just beginning to emerge.

Bibliography

Ayres, Jerry B. "Rural Elementary Children's Attitude Toward the Energy Crisis," School Science and Mathematics 76 (3): 238-240 (March, 1976).

Barrow, Lloyd H. "Influence of Three-Mile Island on Energy Attitudes of Sixth-Graders," in preparation.

Glass, Lynn W. "Outcomes of an Energy Education Workshop for Secondary School Science Teachers," a paper presented to the fifty-second annual meeting of the National Association for Research for Research in Science Teaching, Atlanta, March 22, 1979.

McDermott, John J. (Ed). A Teacher's Guide for Environmental Impact of Electrical Power Generation: Nuclear and Fossil. Harrisburg: Pennsylvania Department of Education, 1973.

National Assessment of Educational Progress. Energy Knowledge and Attitudes, Denver, December, 1978.

Nie, Norman, et al. Statistical Package for the Social Sciences. New York: McGraw-Hill Book Company, 1975.

Figure 1

Staff Design and Components

School	A	X_1	X_2	X_3	
School	B	X_1			
School	C	X_1			X_4
School	D	X_1		X_3	

X_1 = Used EFTT Module

X_2 = Studied scientific principles of energy, but not EFTT

X_3 = Control

X_4 = EFTT pre-post analysis

Table 1

Means, Standard Deviations and t-values for Pre-Post Group (n=23)

	Pre $\bar{x}$	Pre S.D.	Post $\bar{x}$	Post S.D.	t
Man is responsible for spoiling his environment.	2.30	1.22	1.70	0.82	1.98
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.78	1.31	2.35	1.37	1.10
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.35	0.89	3.57	1.38	-0.64
The use of electric cars will not effect the environment.	3.27	1.34	2.65	1.30	2.34**
We must produce electricity at any cost.	3.00	1.13	4.35	0.94	-4.41***
All types of electrical generation cause pollution.	3.44	1.24	3.87	1.18	-1.22
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.70	1.19	3.74	1.39	-0.11
We must stop all forms of pollution.	2.04	1.30	1.91	1.13	0.36
Nuclear power plants are dangerous to life and property.	2.83	1.11	1.83	0.99	3.23**
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.96	0.88	2.09	0.85	3.42***
Nuclear power plants are safe.	3.70	1.19	4.52	0.73	-2.85**
Nuclear reactors must be developed to extend our fuel supply.	2.39	0.72	2.04	1.07	1.30
Power plants must be located near major population centers.	3.52	1.16	2.35	1.03	3.63***
We must stop the generation of electrical energy to save our environment.	3.83	1.07	3.70	0.77	0.47
Oil and natural gas are too valuable as raw materials to save our environment.	3.22	1.13	2.70	1.36	1.42
We must make the best possible use of all resources.	1.52	1.08	1.61	0.72	-0.32
Nuclear power must be stopped.	3.44	0.99	3.70	0.82	-0.97
Total	51.57	5.46	48.65	5.05	1.88

*Significant at .05
**Significant at .01
***Significant at .001

Table 2

Means, Standard Deviations and t-values for Females of Pre and Post Group (n=11)

	Pre $\bar{x}$	Pre S.D.	Post $\bar{x}$	Post S.D.	t
Man is responsible for spoiling his environment.	2.46	1.29	1.75	0.75	1.58
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	3.00	1.18	2.33	1.16	1.37
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.36	0.92	3.33	1.14	0.06
The use of electric cars will not effect the environment.	3.73	1.10	2.33	1.23	2.86**
We must produce electricity at any cost.	2.91	1.04	4.50	0.52	-4.56***
All types of electrical generation cause pollution.	3.18	1.08	3.75	1.22	-1.19
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	4.09	1.22	3.92	1.44	0.31
We must stop all forms of pollution.	1.55	1.21	1.67	0.89	-0.27
Nuclear power plants are dangerous to life and property.	3.00	0.89	1.83	1.12	2.78**
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	3.18	0.41	1.92	0.79	4.88***
Nuclear power plants are safe.	3.46	0.93	4.75	0.45	-4.17***
Nuclear reactors must be developed to extend our fuel supply.	2.46	0.82	1.83	1.03	1.61
Power plants must be located near major population centers.	3.64	1.12	1.92	0.67	4.42***
We must stop the generation of electrical energy to save our environment.	3.36	1.29	3.67	0.89	-0.65
Oil and natural gas are too valuable as raw materials to save our environment.	3.27	1.19	2.67	1.37	1.13
We must make the best possible use of all resources.	1.18	0.41	1.50	0.52	-1.64
Nuclear power must be stopped.	3.18	0.87	3.75	0.75	-1.66
Total	51.00	5.57	47.42	4.06	1.75

*Significant at .05
**Significant at .01
***Significant at .001

Table 3

Means, Standard Deviations and t-Values for Males of Pre-Post Group (n=12)

	Pre		Post		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.17	1.19	1.64	0.92	1.20
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.58	1.44	2.36	1.63	0.34
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.33	0.88	3.82	1.33	-1.02
The use of electric cars will not effect the environment.	3.42	1.56	3.00	1.34	0.69
We must produce electricity at any cost.	3.08	1.24	4.18	1.25	-2.11*
All types of electrical generation cause pollution.	3.67	1.37	4.00	1.18	-0.63
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.33	1.07	3.55	1.37	-0.41
We must stop all forms of pollution.	2.50	1.24	2.18	1.33	0.59
Nuclear power plants are dangerous to life and property.	2.67	1.30	1.82	0.87	1.85
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.75	1.14	2.27	0.91	1.12
Nuclear power plants are safe.	3.92	1.38	4.27	0.91	-0.74
Nuclear reactors must be developed to extend our fuel supply.	2.33	0.65	2.27	1.10	0.16
Power plants must be located near major population centers.	3.42	1.24	2.82	1.17	1.19
We must stop the generation of electrical energy to save our environment.	4.25	0.62	3.73	0.65	1.97
Oil and natural gas are too valuable as raw materials to save our environment.	3.17	1.12	2.73	0.91	0.82
We must make the best possible use of all resources.	1.83	1.40	1.73	0.91	0.22
Nuclear power must be stopped.	3.67	1.07	3.64	0.92	0.07
Total	52.08	5.55	50.00	5.85	0.87

*Significant at .05

Table 4

Means and Standard Deviations for Pre Groups

	Pre					
age	11		12		13	
	Male	Female	Male	Female	Male	Female
n	8	7	3	4	1	0
Man is responsible for spoiling his environment.	2.38 1.06	2.43 1.13	2.00 1.73	2.50 1.73	1.00 ---	--- ---
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.37 1.60	2.86 0.90	2.67 1.16	3.25 1.71	4.00 ---	--- ---
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.50 0.93	3.43 0.79	3.00 1.00	3.25 1.26	3.00 ---	--- ---
The use of electric cars will not effect the environment	3.13 1.64	3.86 1.07	4.67 0.58	3.50 1.29	2.00 ---	--- ---
We must produce electricity at any cost.	3.38 1.30	2.86 0.69	3.00 ---	3.00 1.63	1.00 ---	--- ---
All types of electrical generation cause pollution.	4.00 1.31	3.14 0.90	3.67 0.58	3.25 1.50	1.00 ---	--- ---
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.25 1.04	3.57 1.27	3.00 1.00	5.00 ---	5.00 ---	--- ---
We must stop all forms of pollution.	2.38 1.06	1.43 1.13	3.33 1.53	1.75 1.50	1.00 ---	--- ---
Nuclear power plants are dangerous to life and property.	2.38 1.06	2.71 0.95	4.00 1.00	3.56 0.58	1.00 ---	--- ---
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.63 1.30	3.00 ---	3.33 0.58	3.50 0.58	2.00 ---	--- ---
Nuclear power plants are safe.	4.00 1.20	3.57 0.79	3.33 2.08	3.25 1.26	5.00 ---	--- ---
Nuclear reactors must be developed to extend our fuel supply.	2.25 0.71	2.57 0.79	2.33 0.58	2.25 0.96	3.00 ---	--- ---
Power plants must be located near major population centers.	3.38 1.30	3.29 0.76	3.67 1.53	4.25 1.50	3.00 ---	--- ---
We must stop the generation of electrical energy to save our environment.	4.38 0.52	3.00 1.41	4.00 1.00	4.00 0.82	4.00 ---	--- ---
Oil and natural gas are too valuable as raw materials to save our environment.	3.38 0.74	2.86 1.22	3.33 1.53	4.00 0.82	1.00 ---	--- ---
We must make the best possible use of all resources.	1.88 1.46	1.29 0.49	2.00 1.73	1.00 ---	1.00 ---	--- ---
Nuclear power must be stopped.	3.38 1.06	3.28 0.49	4.33 1.16	3.00 1.41	4.00 ---	--- ---
Total Score	52.00 4.21	49.14 3.76	55.67 6.11	54.25 7.27	42.00 ---	--- ---

Table 5

Means and Standard Deviations for Post-Test Group

	age	11		12		13	
		Male	Female	Male	Female	Male	Female
	n=	7	7	3	4	1	--
Man is responsible for spoiling his environment.		1.43	2.00	2.33	1.40	1.00	---
		0.54	0.82	1.53	0.55	---	---
Electrical plants which burn coal or oil are less dangerous than nuclear plants.		1.86	2.86	2.67	1.60	5.00	---
		1.22	1.22	2.08	0.55	---	---
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.		3.57	3.86	4.67	2.60	3.00	---
		1.51	1.22	0.58	1.52	---	---
The use of electric cars will not effect the environment.		2.86	2.57	3.33	2.00	3.00	---
		1.46	1.13	1.53	1.41	---	---
We must produce electricity at any cost.		4.00	4.29	4.33	4.80	5.00	---
		1.53	0.49	0.58	0.45	---	---
All types of electrical generation cause pollution.		4.00	3.57	3.67	4.00	5.00	---
		1.15	1.27	1.53	1.23	---	---
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.		3.57	4.14	3.33	3.60	4.00	---
		1.27	1.07	2.08	1.95	---	---
We must stop all forms of pollution.		2.57	1.71	1.67	1.60	1.00	---
		1.51	0.49	0.58	1.34	---	---
Nuclear power plants are dangerous to life and property.		1.57	2.00	2.33	1.60	2.00	---
		0.53	1.41	1.53	0.55	---	---
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.		2.43	2.00	1.67	1.80	3.00	---
		0.98	1.00	0.58	0.45	---	---
Nuclear power plants are safe.		4.57	4.86	3.67	4.60	4.00	---
		0.53	0.38	1.53	0.55	---	---
Nuclear reactors must be developed to extend our fuel supply.		2.43	1.86	1.67	1.80	3.00	---
		1.27	0.90	0.58	1.30	---	---
Power plants must be located near major population centers.		2.71	2.00	3.00	1.80	3.00	---
		1.38	0.82	1.00	0.45	---	---
We must stop the generation of electrical energy to save our environment.		3.57	3.29	4.00	4.20	4.00	---
		0.79	0.95	---	0.45	---	---
Oil and natural gas are too valuable as raw materials to save our environment.		2.86	2.57	2.33	2.80	3.00	---
		1.57	1.33	1.53	1.79	---	---
We must make the best possible use of all resources.		1.86	1.57	1.33	1.40	2.00	---
		1.07	0.54	0.58	0.55	---	---
Nuclear power must be stopped.		3.57	3.43	4.00	4.20	3.00	---
		0.98	0.79	1.00	0.45	---	---
Total Score		49.43	48.57	50.00	45.80	54.00	---
		6.90	3.10	4.36	5.02	---	---

Table 6

Mean and Standard Deviation for EFTT

age	11		12		13		14	
	Male	Female	Male	Female	Male	Female	Male	Female
n=	45	51	30	29	5	2	1	
Man is responsible for spoiling his environment.	1.73	2.22	2.20	1.72	2.00	1.50	3.00	---
	1.03	0.88	1.21	1.03	1.22	0.71	---	---
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.20	2.51	2.73	2.34	3.40	2.00	2.00	---
	0.99	1.10	1.44	1.20	1.52	1.41	---	---
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	2.27	2.69	2.80	2.35	3.00	2.00	4.00	---
	1.01	1.18	1.30	1.08	1.22	---	---	---
The use of electric cars will not effect the environment.	3.29	3.29	3.10	3.35	3.20	2.50	1.00	---
	1.26	1.27	1.49	1.29	1.79	2.12	---	---
We must produce electricity at any cost.	3.69	3.61	3.03	3.69	3.60	2.50	3.00	---
	1.20	1.23	1.45	1.17	1.34	0.71	---	---
All types of electrical generation cause pollution.	2.89	2.88	3.37	2.79	3.30	2.50	2.00	---
	1.28	1.32	1.38	1.45	1.64	0.71	---	---
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.20	3.45	2.83	3.76	2.20	3.50	5.00	---
	1.18	1.14	1.23	1.30	1.30	0.71	---	---
We must stop all forms of pollution.	1.91	1.94	1.87	1.58	2.40	2.00	4.00	---
	1.22	1.16	1.28	0.91	1.14	---	---	---
Nuclear power plants are dangerous to life and property.	2.13	2.17	2.37	2.14	1.80	3.00	2.00	---
	1.12	1.09	1.25	0.92	0.84	---	---	---
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.51	2.55	2.67	2.55	4.20	3.00	1.00	---
	1.16	1.05	1.18	1.02	1.10	2.83	---	---
Nuclear power plants are safe.	3.98	3.50	3.20	3.72	3.40	3.00	2.00	---
	1.18	1.07	1.38	1.03	1.82	---	---	---
Nuclear reactors must be developed to extend our fuel supply.	2.42	2.47	2.40	2.48	2.60	2.00	4.00	---
	0.99	0.90	1.16	1.15	0.89	---	---	---
Power plants must be located near major population centers.	2.93	2.80	3.40	3.10	3.40	2.50	3.00	---
	1.19	1.11	1.13	1.01	0.89	0.71	---	---
We must stop the gneeration of electrical energy to save our environment.	2.93	3.04	3.00	2.86	3.60	1.50	3.00	---
	1.01	1.18	1.23	1.27	1.14	0.71	---	---
Oil and natural gas are too valuable as raw materials to save our environment.	2.60	2.86	2.53	2.79	3.40	2.50	1.00	---
	1.14	1.20	1.43	1.32	1.14	2.12	---	---
We must make the best possible use of all resources.	1.96	2.20	1.77	2.03	2.00	4.00	2.00	---
	0.88	0.87	0.77	0.77	0.71	1.41	---	---
Nuclear power must be stopped.	3.24	3.22	3.90	3.10	2.80	2.00	2.00	---
	1.19	0.88	1.02	1.18	1.48	---	---	---
Total Score	45.89	46.92	47.17	46.38	50.80	42.00	44.00	---
	5.11	5.91	5.55	7.11	12.50	5.66	---	---

Table 7

Means and Standard Deviations for Control Group

	age	11		12	
		Male	Female	Male	Female
	n=	20	29	6	7
Man is responsible for spoiling his environment.		2.60	2.00	1.83	3.14
		1.47	2.89	0.41	1.07
Electrical plants which burn coal or oil are less dangerous than nuclear plants.		3.10	2.52	3.17	3.29
		1.21	1.02	1.17	1.60
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.		2.70	2.14	2.50	3.35
		1.46	1.07	1.22	0.89
The use of electric cars will not effect the environment.		2.90	3.21	3.50	3.43
		1.45	1.42	0.84	1.51
We must produce electricity at any cost.		2.90	2.89	2.83	2.00
		1.52	1.41	1.47	1.41
All types of electrical generation cause pollution.		4.25	2.93	3.67	2.71
		0.97	1.25	1.37	1.38
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.		3.45	3.24	3.83	3.28
		1.40	0.87	1.17	1.25
We must stop all forms of pollution.		1.95	1.97	2.00	1.57
		1.50	1.32	0.89	0.79
Nuclear power plants are dangerous to life and property.		2.30	1.97	2.33	2.00
		1.34	0.94	1.21	1.16
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.		2.75	2.45	2.50	2.15
		1.29	1.06	1.52	1.07
Nuclear power plants are safe.		3.85	3.72	3.50	3.71
		1.14	1.28	1.05	1.25
Nuclear reactors must be developed to extend our fuel supply.		2.50	2.72	2.83	3.00
		0.83	0.96	1.17	---
Power plants must be located near major population centers.		3.50	2.83	3.33	3.00
		1.32	1.00	0.82	1.00
We must stop the generation of electrical energy to save our environment.		3.25	2.62	3.17	3.43
		1.16	0.82	1.17	0.98
Oil and natural gas are too valuable as raw materials to save our environment.		2.75	2.72	2.50	2.86
		1.37	1.10	1.38	1.35
We must make the best possible use of all resources.		1.45	1.66	2.00	1.86
		0.95	0.90	1.10	1.07
Nuclear power must be stopped.		3.70	3.06	3.17	2.86
		1.13	1.19	1.17	1.22
Total Score		49.90	45.41	48.67	46.43
		5.88	6.00	5.16	5.74

Table 8

Means and Standard Deviations for Group That Studied Energy Concepts

	age	11		12	
		Male	Female	Male	Female
	n	8	10	2	4
Man is responsible for spoiling his environment.		2.00 0.93	2.40 1.51	4.50 0.71	2.25 1.26
Electrical plants which burn coal or oil are less dangerous than nuclear plants.		2.63 1.51	3.30 0.95	3.00 1.41	3.25 0.50
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.		3.63 1.41	3.60 1.17	2.00 1.41	2.25 1.26
The use of electric cars will not effect the environment.		3.50 1.41	3.60 1.27	4.50 0.71	4.00 0.82
We must produce electricity at any cost.		3.38 0.92	2.80 1.34	3.50 0.71	3.25 0.96
All types of electrical generation cause pollution.		3.50 1.51	2.40 0.97	4.00 ---	1.00 ---
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.		4.25 0.71	3.60 1.27	3.00 1.41	2.75 0.96
We must stop all forms of pollution.		1.63 1.06	1.40 0.97	1.00 ---	1.00 ---
Nuclear power plants are dangerous to life and property.		2.63 1.06	2.70 0.82	1.50 0.71	1.25 0.50
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.		3.00 0.93	2.80 0.92	2.00 ---	2.25 0.96
Nuclear power plants are safe.		4.00 1.07	4.00 0.67	4.50 0.71	4.25 0.96
Nuclear reactors must be developed to extend our fuel supply.		2.88 0.83	2.20 1.03	3.00 ---	2.50 0.58
Power plants must be located near major population centers.		3.63 1.41	2.90 1.29	3.00 1.41	3.25 1.50
We must stop the generation of electrical energy to save our environment.		3.00 1.31	3.30 1.26	2.50 2.12	2.25 1.50
Oil and natural gas are too valuable as raw materials to save our environement.		4.00 0.76	2.60 0.97	4.00 ---	4.00 0.82
We must make the best possible use of all resources.		1.38 0.52	1.60 0.70	1.50 0.71	2.25 0.50
Nuclear power must be stopped.		3.25 1.28	3.00 0.67	3.00 1.41	3.00 0.82
Total Score		52.50 5.95	48.20 4.26	50.50 6.36	44.75 3.40

Table 9

Analysis of Variance for Total Score

Source of Variation	ss	df	ms	f
Main Effects	216.52	3	72.17	
Treatment	132.88	2	66.4	1.98
Sex	95.32	1	95.32	2.84
Interaction				
Treatment X Sex	277.85	2	138.93	4.14**
Explained	494.37	5	98.87	
Residual	8156.73	243	33.57	
Total	8651.11	248	34.88	

* $p < .05$

** $p < .01$

Table 10

Analysis of Variance Regarding Nuclear Power Attitudes

Source of Variation	ss	df	ms	f
Main Effects	22.54	3	7.512	
Treatment	9.03	2	4.52	1.20
Sex	15.05	1	15.05	4.32*
Interaction				
Treatment X Sex	2.75	2	1.38	0.40
Explained	25.29	5	5.06	1.45
Residual	846.67	243	3.48	
Total	871.96	248	3.52	

* $p < .05$

Table 11

Analysis of Variance Toward Environmental Impact of Electrical Power Generation

Source of Variation	ss	df	ms	f
Main Effects	30.14	3	10.05	
Treatment	18.64	2	9.32	0.61
Sex	13.51	1	13.51	0.89
Interactions				
Treatment X Sex	108.91	2	54.46	3.59*
Explained	139.06	5	27.81	1.83
Residual	3689.72	243	15.18	
Total	3828.77	248	15.44	

* $p < .05$

Table 12

Analysis of Variance of Electrical Power Generation Attitudes

Sources of Variation	ss	df	ms	f
Main Effects	32.66	3	10.89	
Treatment	28.34	2	14.17	1.95
Sex	4.88	1	4.88	0.67
Interactions				
Treatment X Sex	21.82	2	10.91	1.51
Explained	54.48	5	10.90	
Residual	1761.78	243	7.25	
Total	1816.27	248	7.32	

Table 13

Means, Standard Deviations, and t-values for School A
Comparing Control and Energy Group

	Control n=26		Energy n=24		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.08	0.98	2.42	1.35	-1.01
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	3.27	1.08	3.04	1.12	0.73
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.00	1.20	3.25	1.36	-0.69
The use of electric cars will not effect the environment.	3.08	1.32	3.71	1.20	-1.77
We must produce electricity at any cost.	3.23	1.42	3.13	0.99	0.31
All types of electrical generation cause pollution.	3.89	0.99	2.67	1.40	3.52***
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.35	1.29	3.63	1.14	-0.81
We must stop all forms of pollution.	3.42	1.53	1.38	0.88	3.00**
Nuclear power plants are dangerous to life and property.	2.50	1.11	2.33	1.01	0.56
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.81	1.06	2.71	0.91	0.36
Nuclear power plants are safe.	3.58	1.17	4.08	0.83	-1.77
Nuclear reactors must be developed to extend our fuel supply.	2.50	0.71	2.54	0.88	-0.18
Power plants must be located near major population centers.	3.27	1.19	3.21	1.32	0.17
We must stop the generation of electrical energy to save our environment.	3.23	0.95	2.96	1.33	0.83
Oil and natural gas are too valuable as raw materials to save our environment.	3.19	1.10	3.42	1.06	-0.74
We must make the best possible use of all resources.	1.58	0.95	1.63	0.65	-0.21
Nuclear power must be stopped.	3.77	0.91	3.08	0.93	2.64**
Total	50.73	5.19	49.17	5.33	1.05

*Significant at .05
**Significant at .01
***Significant at .001

Table 14

Means, Standard Deviations, and t-values for School A
Males Comparing Control and Energy Groups

	Control n=15		Energy n=10		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.33	1.11	2.50	1.35	-0.32
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	3.53	0.92	2.70	1.42	1.64
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.00	1.41	3.30	1.49	-0.50
The use of electric cars will not effect the environment.	2.73	1.22	3.70	1.34	-1.83
We must produce electricity at any cost.	3.20	1.47	3.40	0.84	-0.43
All types of electrical generation cause pollution.	4.07	0.80	3.60	1.35	0.98
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.67	1.35	4.00	0.94	-0.73
We must stop all forms of pollution.	2.67	1.62	1.50	0.97	1.47
Nuclear power plants are dangerous to life and property.	2.73	1.28	2.40	1.08	0.70
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.87	1.25	2.80	0.92	0.15
Nuclear power plants are safe.	3.53	1.19	4.10	0.99	-1.29
Nuclear reactors must be developed to extend our fuel supply.	2.47	0.83	2.90	0.74	-1.36
Power plants must be located near major population centers.	3.33	1.29	3.50	1.35	-0.31
We must stop the generation of electrical energy to save our environment.	3.20	1.08	2.90	1.37	-0.58
Oil and natural gas are too valuable as raw materials to save our environment.	3.20	1.32	4.00	0.67	-2.00
We must make the best possible use of all resources.	1.53	1.06	1.40	0.52	0.42
Nuclear power must be stopped.	3.93	0.80	3.20	1.22	1.67
Total	51.60	4.87	51.90	5.71	-0.14

Table 15

Means, Standard Deviations, and t-values for School A
Females Comparing Control and Energy Groups

	Control n=11		Energy n=14		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment	1.73	0.65	2.36	1.39	-1.50
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.91	1.22	3.29	0.83	-0.88
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	3.00	0.89	3.21	1.31	-0.48
The use of electric cars will not effect the environment.	3.55	1.37	3.71	1.14	-0.33
We must produce electricity at any cost.	3.27	1.42	2.93	1.07	0.67
All types of electrical generation cause pollution.	3.64	1.21	2.00	1.04	3.58**
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	2.91	1.14	3.36	1.22	-0.95
We must stop all forms of pollution.	2.64	1.43	1.29	0.83	2.78**
Nuclear power plants are dangerous to life and property.	2.18	0.75	2.29	0.99	-0.30
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.73	0.79	2.64	0.93	0.25
Nuclear power plants are safe.	3.64	1.21	4.07	0.73	-1.05
Nuclear reactors must be developed to extend our fuel supply.	2.55	0.52	2.29	0.91	0.89
Power plants must be located near major population centers.	3.18	1.08	3.00	1.30	0.38
We must stop the generation of electrical energy to save our environment.	3.28	0.79	3.00	1.36	0.63
Oil and natural gas are too valuable as raw materials to save our environment.	3.18	0.75	3.00	1.11	0.49
We must make the best possible use of all resources.	1.64	0.81	1.79	0.70	-0.49
Nuclear power must be stopped.	3.55	1.04	3.00	0.68	1.51
Total	49.55	5.61	47.21	4.23	1.15

*Significant at .05
**Significant at .01

Table 16

Means, Standard Deviations and t-values for School A
Comparing EFTT and Energy Groups

	EFTT n=11		Energy n=24		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.64	0.92	2.42	1.35	0.56
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.37	1.63	3.04	1.12	-1.25
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	2.73	1.42	3.25	1.36	-1.02
The use of electric cars will not effect the environment.	3.18	1.40	3.70	1.20	-1.08
We must produce electricity at any cost.	2.82	1.08	3.13	0.99	-0.80
All types of electrical generation cause pollution.	2.91	1.76	2.67	1.40	0.40
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.09	1.22	3.63	1.14	-1.23
We must stop all forms of pollution.	1.91	1.58	1.38	0.88	1.05
Nuclear power plants are dangerous to life and property.	1.64	1.29	2.33	1.01	-1.59
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.18	1.33	2.71	0.91	-1.19
Nuclear power plants are safe.	4.09	1.30	4.08	0.83	0.02
Nuclear reactors must be developed to extend our fuel supply.	2.73	1.35	2.54	0.88	0.42
Power plants must be located near major population centers.	3.55	1.64	3.21	1.32	0.60
We must stop the generation of electrical energy to save our environment.	3.18	1.40	2.96	1.33	0.44
Oil and natural gas are too valuable as raw materials to save our environment.	2.64	1.36	3.42	1.06	-1.68
We must make the best possible use of all resources.	2.36	1.12	1.63	0.65	2.04
Nuclear power must be stopped.	3.36	1.50	3.08	0.93	0.57
Total	47.36	9.44	49.17	5.33	-0.59

Table 17

Means, Standard Deviations and t-values for Males of School A Comparing EFTT and Energy Groups

	EFTT n=4		Energy n=10		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.75	1.50	2.50	1.35	0.29
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	1.75	1.50	2.70	1.42	-1.09
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	2.75	1.71	3.30	1.49	-0.56
The use of electric cars will not effect the environment.	2.75	1.71	3.70	1.34	-1.00
We must produce electricity at any cost.	3.25	1.50	3.40	0.84	-0.19
All types of electrical generation cause pollution.	2.50	1.29	3.60	1.35	-1.42
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.25	1.50	4.00	0.94	-0.93
We must stop all forms of pollution.	1.00	0.00	1.50	0.97	-1.63
Nuclear power plants are dangerous to life and property.	1.00	0.00	2.40	1.08	-4.12**
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	1.75	0.96	2.80	0.92	-1.87
Nuclear power plants are safe.	4.75	0.50	4.10	0.99	1.62
Nuclear reactors must be developed to extend our fuel supply.	1.75	0.96	2.90	0.74	-2.16
Power plants must be located near major population centers.	3.50	1.92	3.50	1.35	0.00
We must stop the generation of electrical energy to save our environment.	3.50	1.29	2.90	1.37	0.77
Oil and natural gas are too valuable as raw materials to save our environment.	1.55	0.58	4.00	0.67	-6.99***
We must make the best possible use of all resources.	1.50	0.58	1.40	0.52	0.30
Nuclear power must be stopped.	3.25	1.71	3.20	1.23	0.05
Total	42.50	4.44	51.90	5.71	-3.29**

*Significant at .05
**Significant at .01
***Significant at .001

Table 18

Means, Standard Deviations and t-values for Females of School A Comparing EFTT and Energy Groups

	EFTT n=7		Energy n=14		t
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Man is responsible for spoiling his environment.	2.57	0.54	2.36	1.39	0.51
Electrical plants which burn coal or oil are less dangerous than nuclear plants.	2.71	1.70	3.29	0.83	-0.84
We should stop the present increase in production of electrical energy until we can be certain of its effects on the environment.	2.71	1.38	3.21	1.31	-0.80
The use of electric cars will not effect the environment.	3.43	1.27	3.71	1.14	-0.50
We must produce electricity at any cost.	2.57	0.79	2.93	1.07	-0.87
All types of electrical generation cause pollution.	3.14	2.04	2.00	1.04	1.40
Man has always adapted to his environment, and he will adapt to the presence of pollution in the environment.	3.00	1.16	3.36	1.22	-0.66
We must stop all forms of pollution.	2.43	1.81	1.29	0.83	1.59
Nuclear power plants are dangerous to life and property.	2.00	1.53	2.29	0.99	-0.45
Fossil fueled plants cause death from air pollution. Nuclear power plants will kill many persons.	2.43	1.51	2.64	0.93	-0.34
Nuclear power plants are safe.	3.71	1.50	4.07	0.73	-0.60
Nuclear reactors must be developed to extend our fuel supply.	3.29	1.25	2.29	0.91	1.88
Power plants must be located near major population centers.	3.57	1.62	3.00	1.30	0.81
We must stop the generation of electrical energy to save our environment.	3.00	1.53	3.00	1.36	0.00
Oil and natural gas are too valuable as raw materials to save our environment.	3.29	1.25	3.00	1.11	0.51
We must make the best possible use of all resources.	2.86	1.07	1.79	0.70	2.41*
Nuclear power must be stopped.	3.43	1.51	3.00	0.68	0.71
Total	50.14	10.67	47.21	4.23	0.70

*Significant at .05